Effect of above-cloud biomass burning aerosol on marine stratocumulus retrievals off Namibia and Angola

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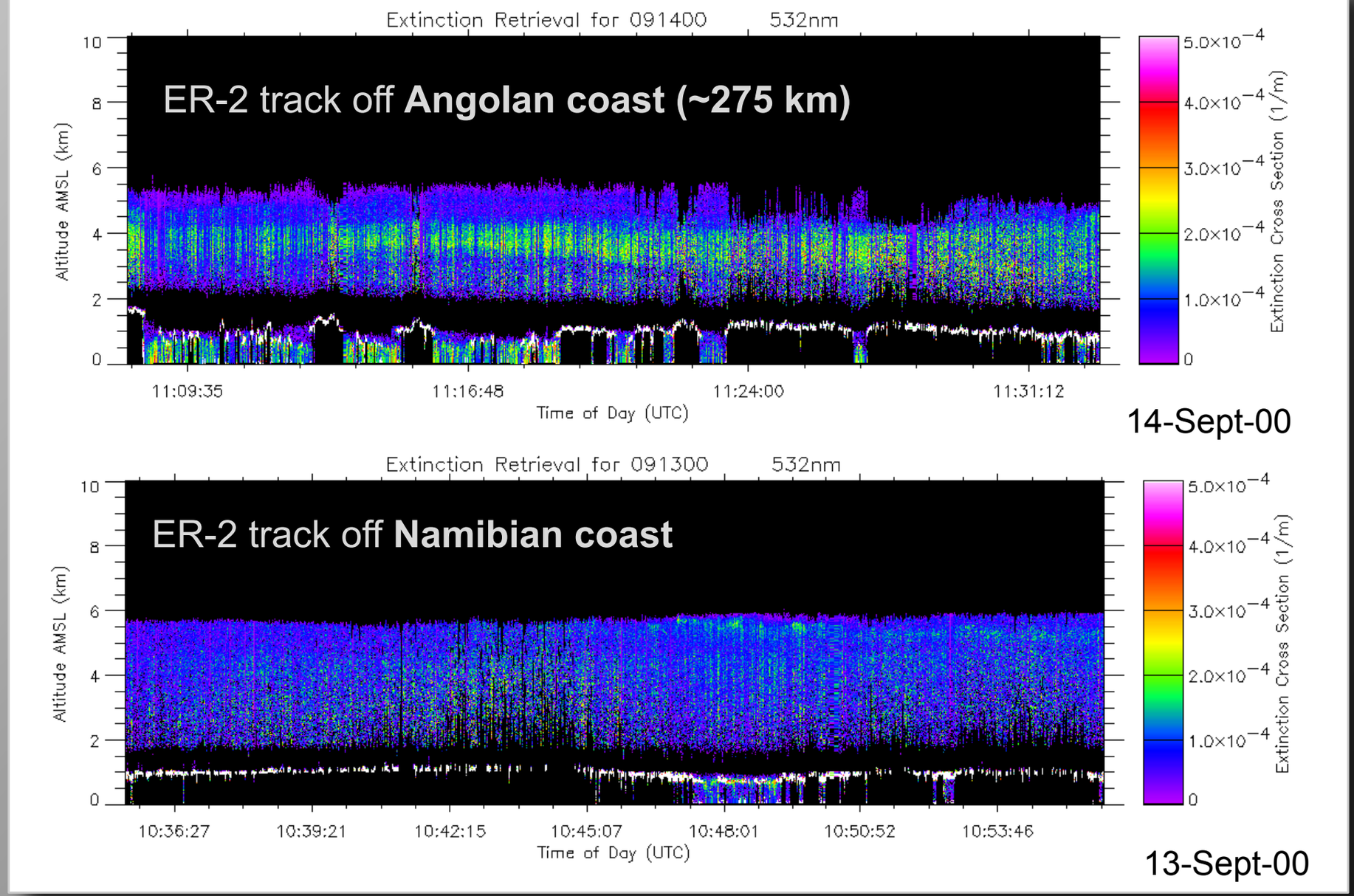
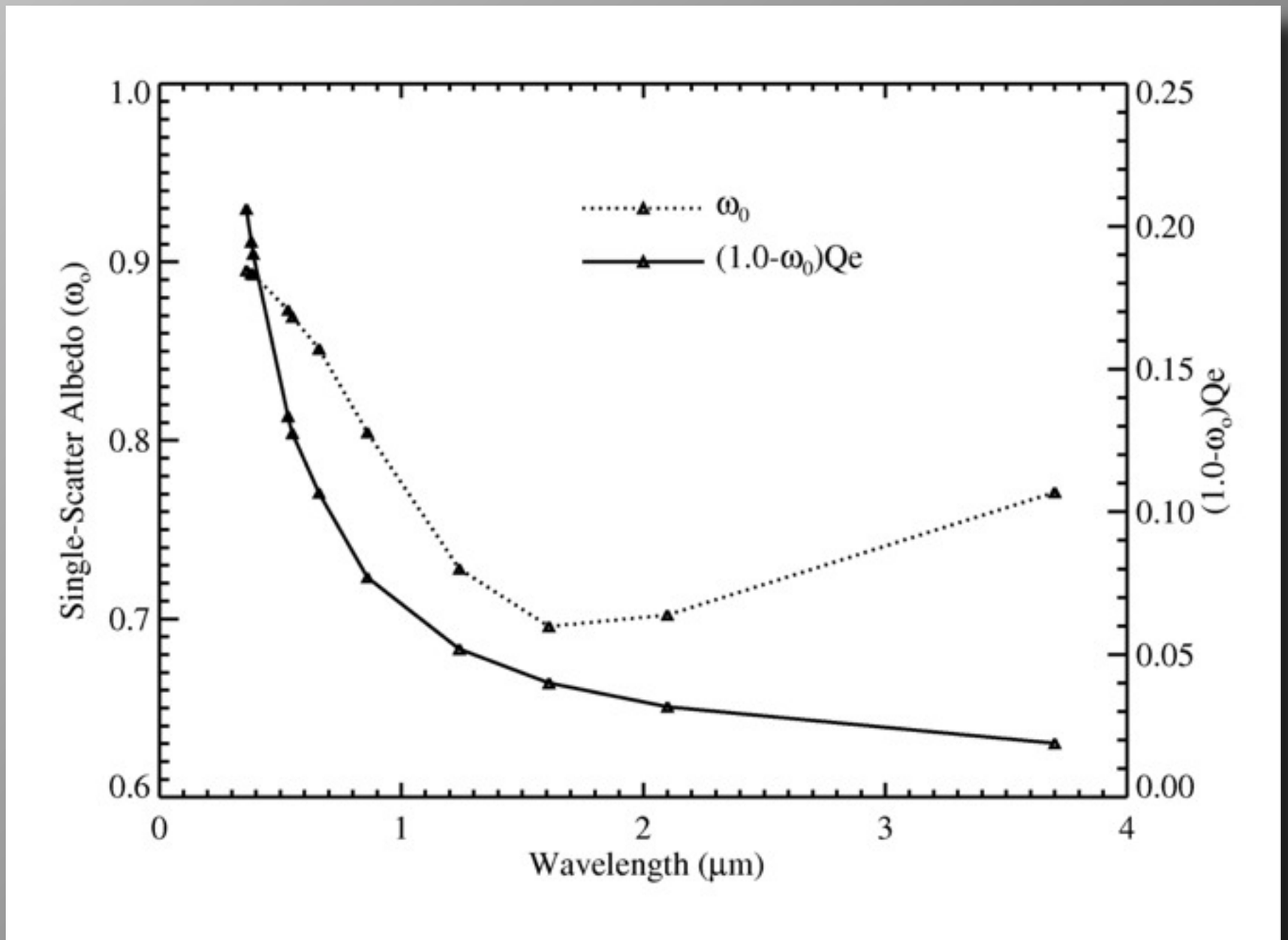
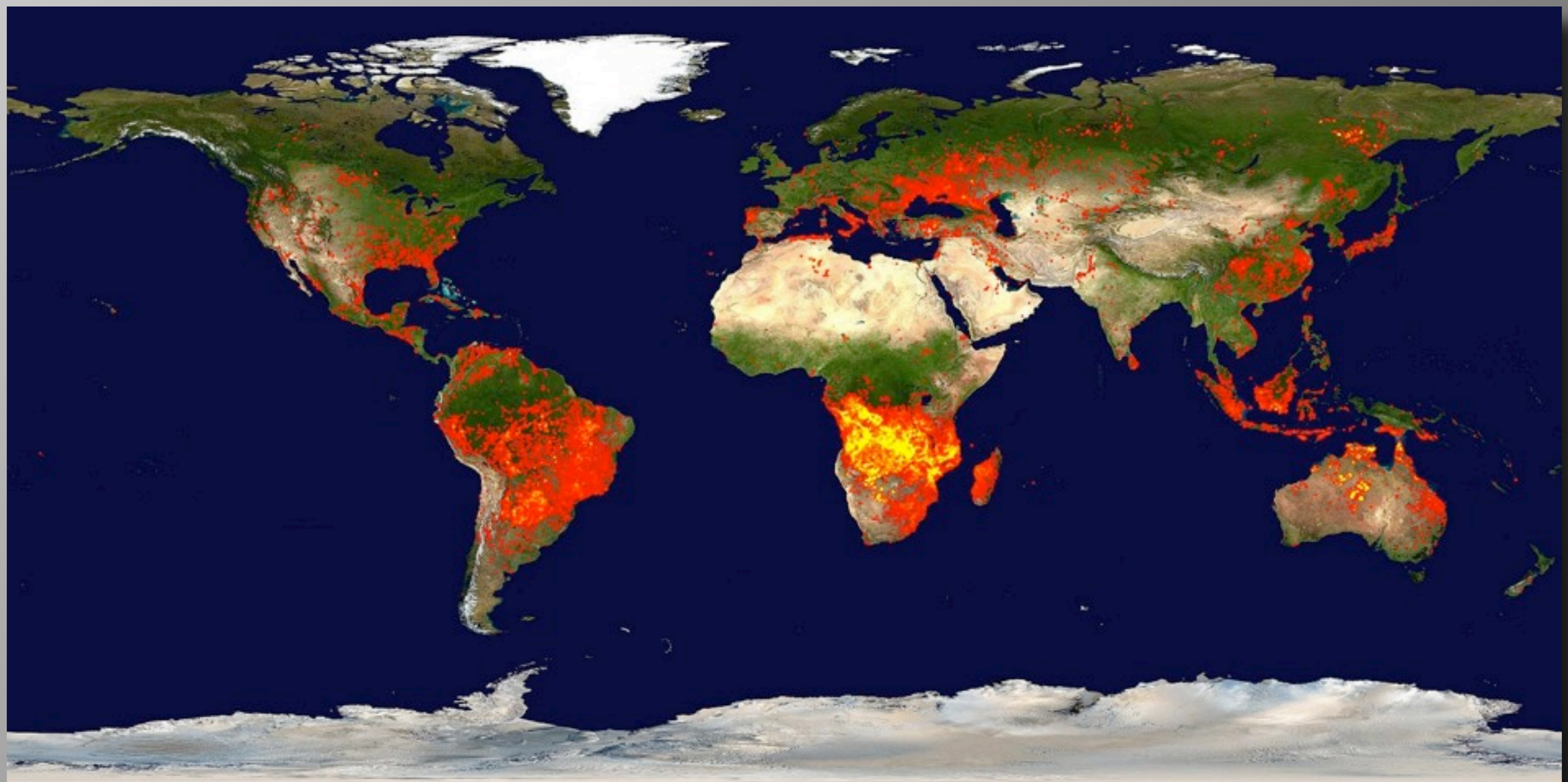


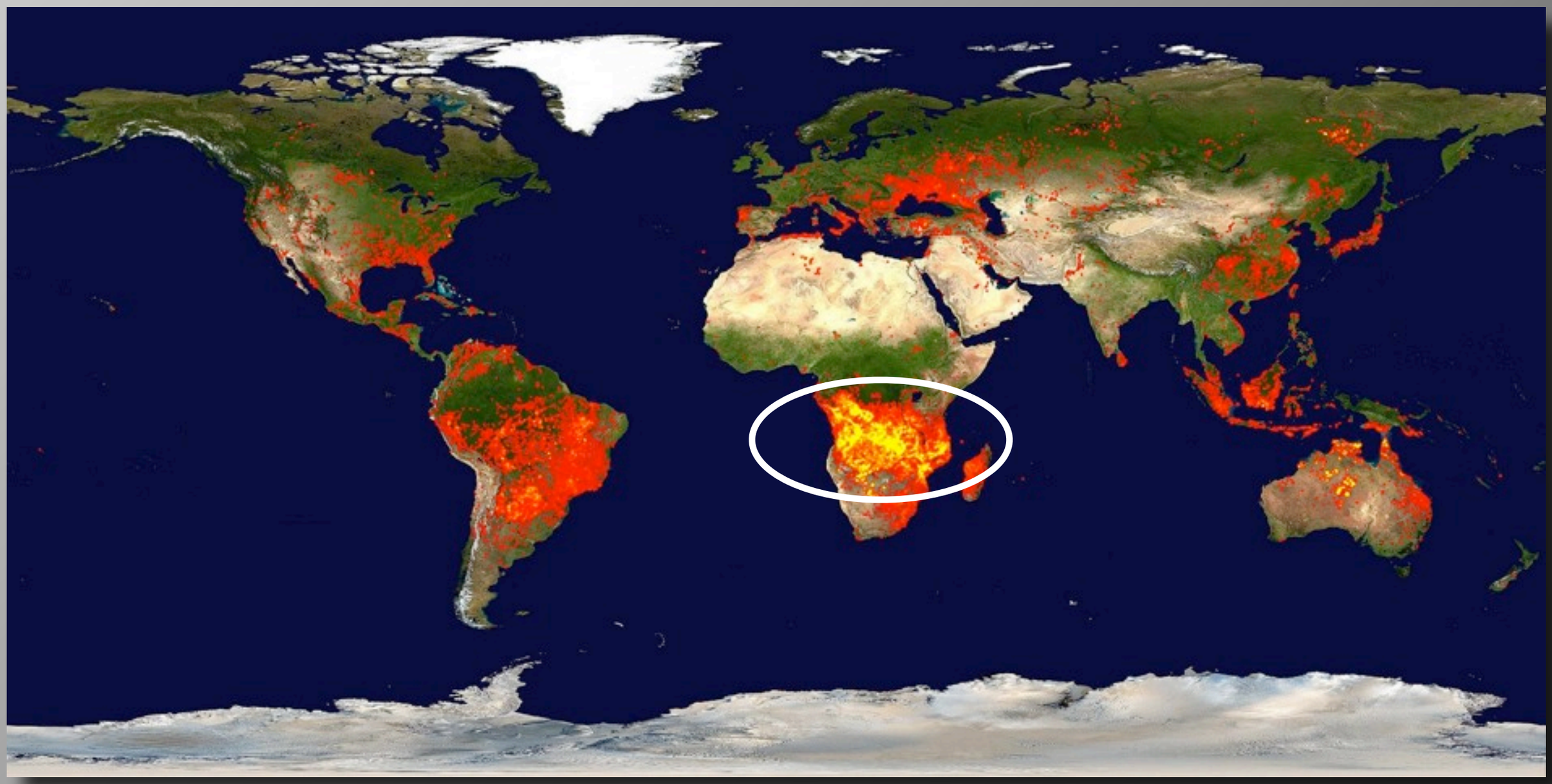
SAFARI 2000: CPL Lidar 532 nm extinction (M. McGill, D. Hlavka)



MOD04 Heavey Absorbing Aerosol Model



Global Fire Map: 8/9/2011 - 8/18/2011 (NASA/GSFC Rapid Response).
Yellow: more fires detected Red: less fires detected



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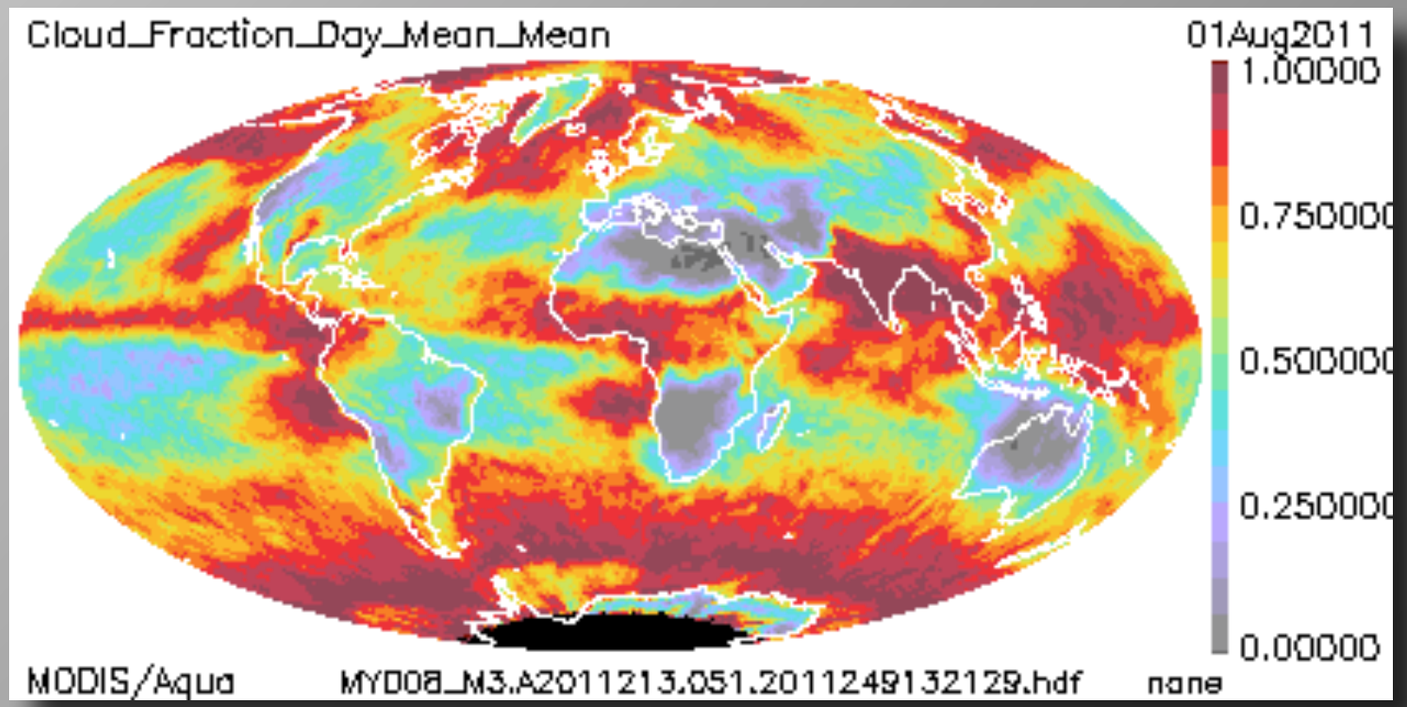
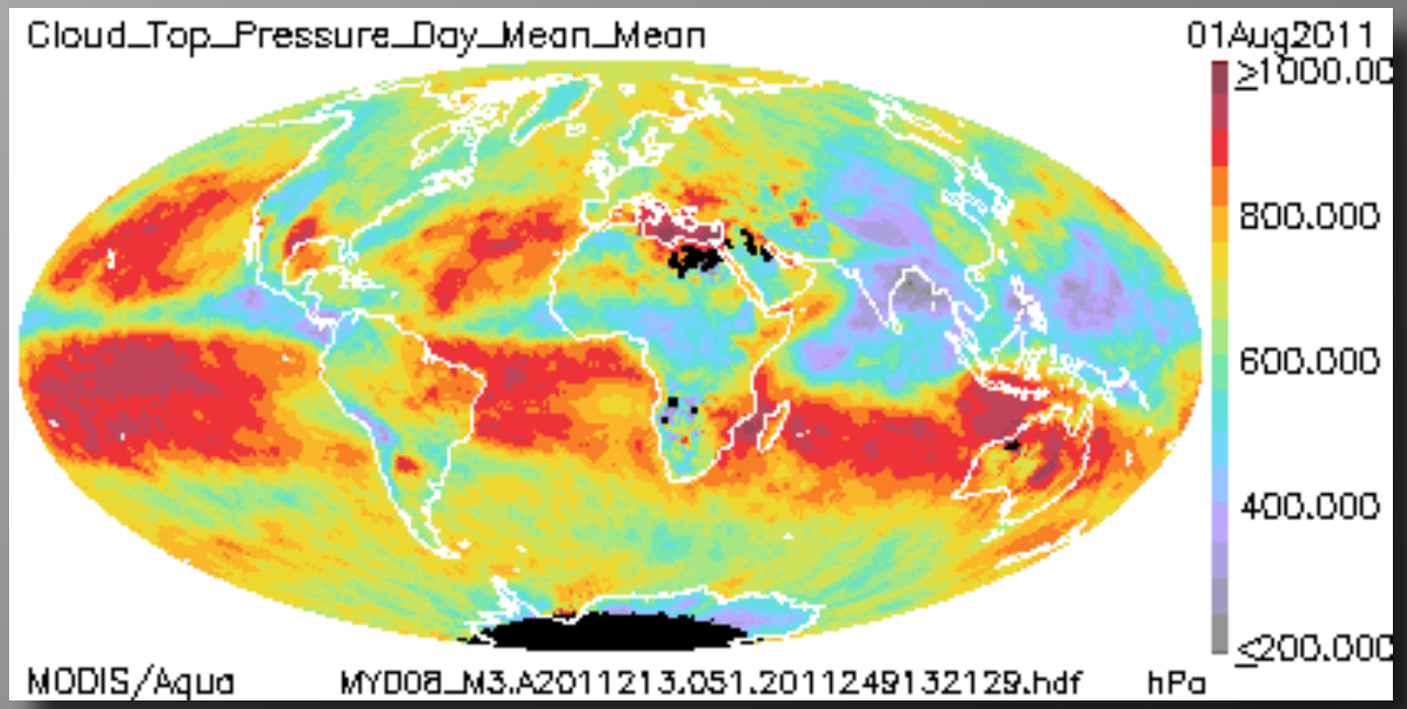
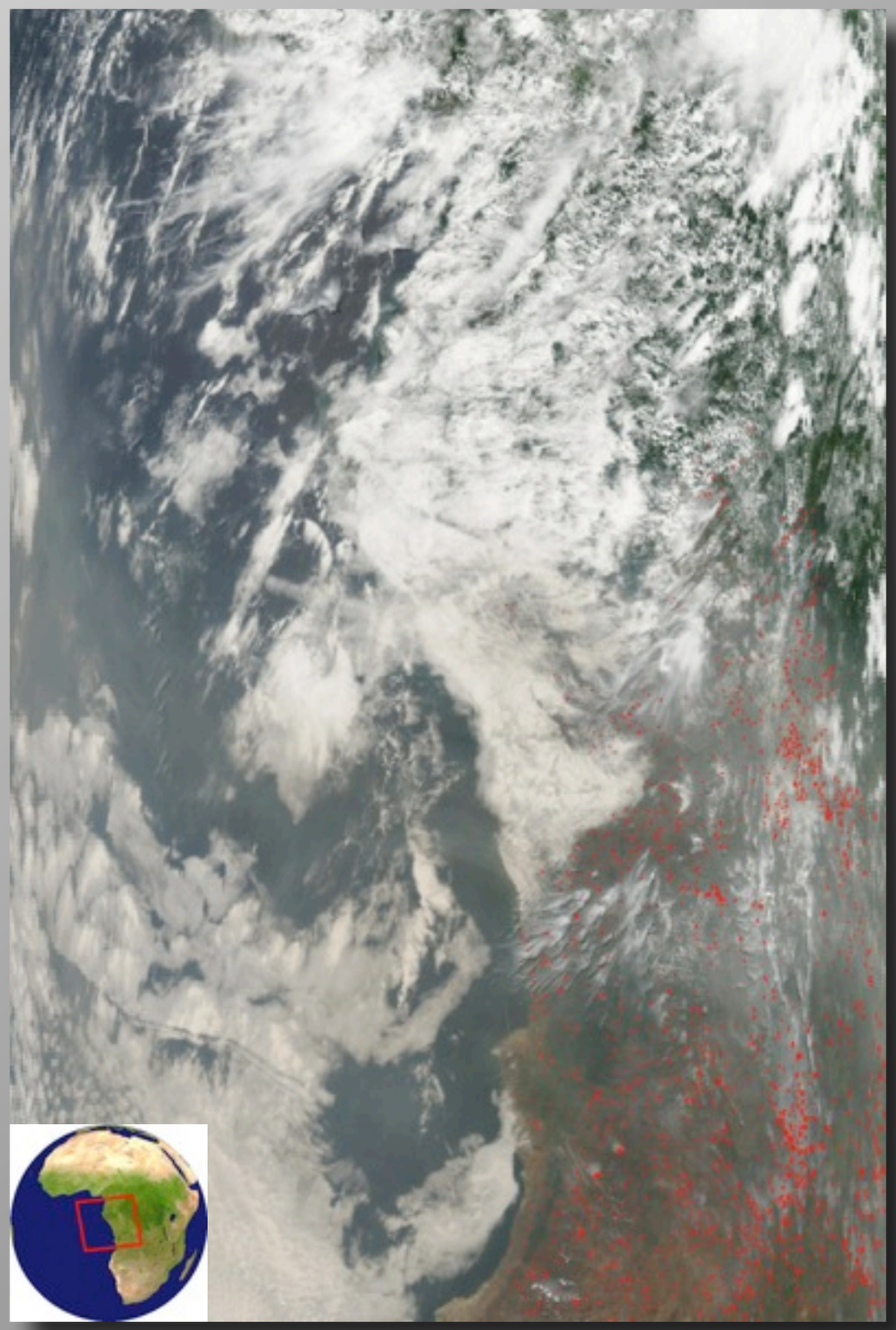




Courtesy MODIS Atmosphere Browse Imagery

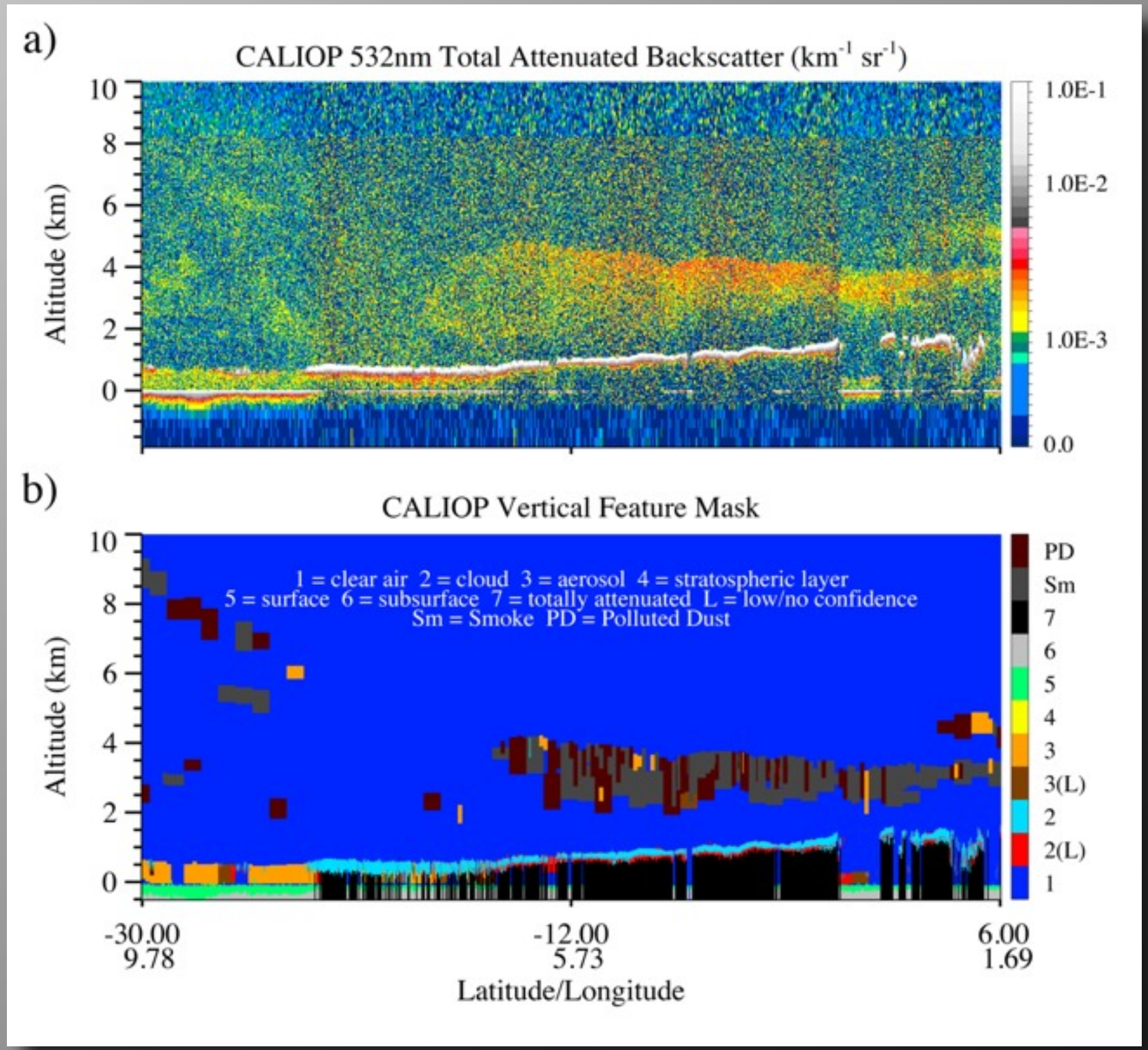


MYD021km: 8/19/2011, 1250 UTC

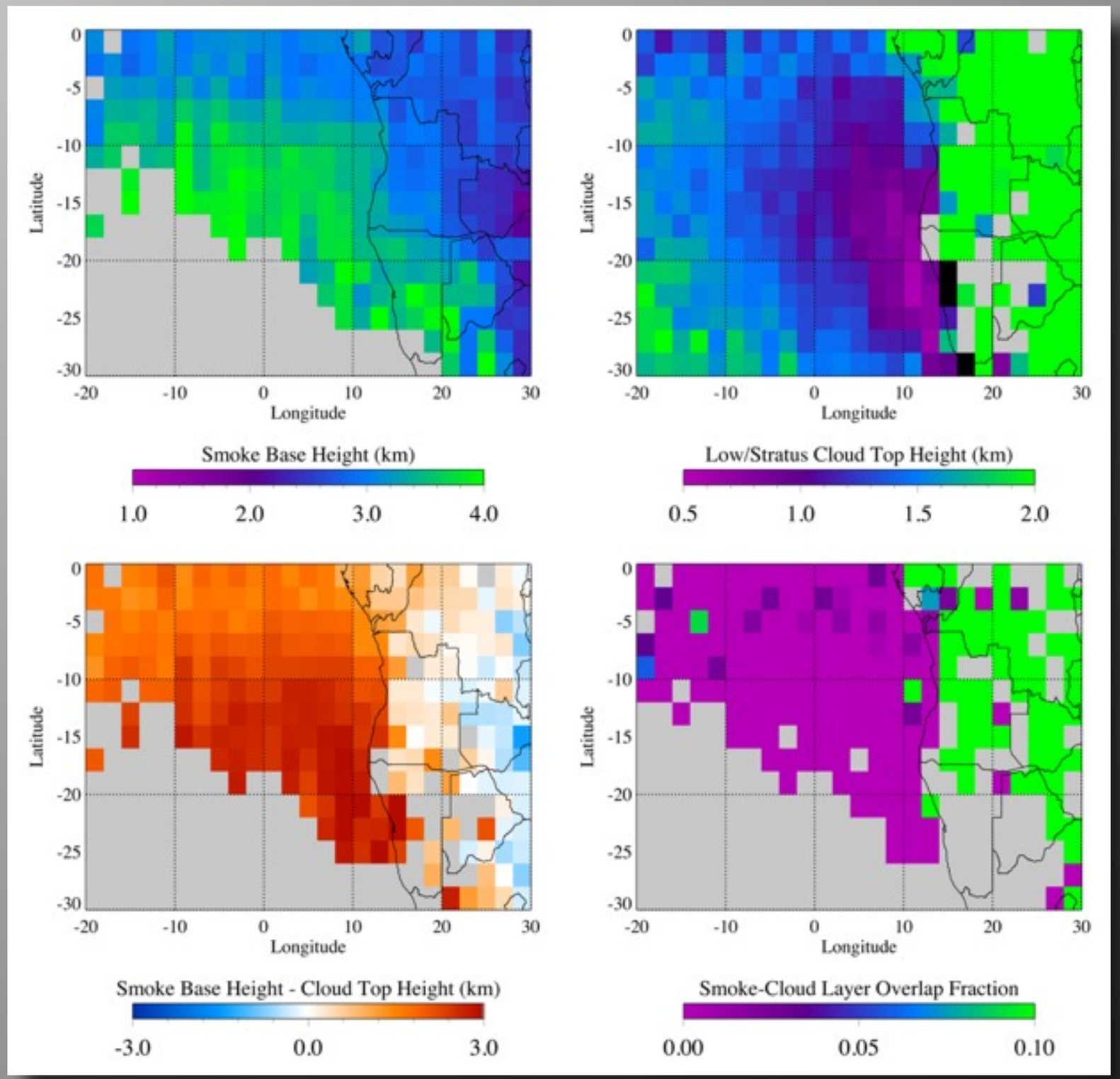
True color: bands 1-4-3 (0.66, 0.55, 0.47 μm)

Goals

- Assess how often the smoke layer entrains into the cloudy boundary layer.
- Build on previous work by investigating biases in the MODIS cloud optical property retrievals (MOD06/MYD06) resulting from the overlying absorbing smoke layer.
- Perform a better assessment of enhanced direct aerosol forcing from the overlying smoke layer.



August 26, 2010 (13:11:09Z Daytime)



August and September 2006-20011 Daytime Orbits

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Effects on MOD06

- Absorbing aerosol properties:
  - MOD04 C5 aerosol models (Remer et al.).
  - MIEV (Wiscombe et al., 1980).
- Look-up tables:
  - Forward RT calculations using DISORT.
  - MOD06 water cloud bulk scattering properties.

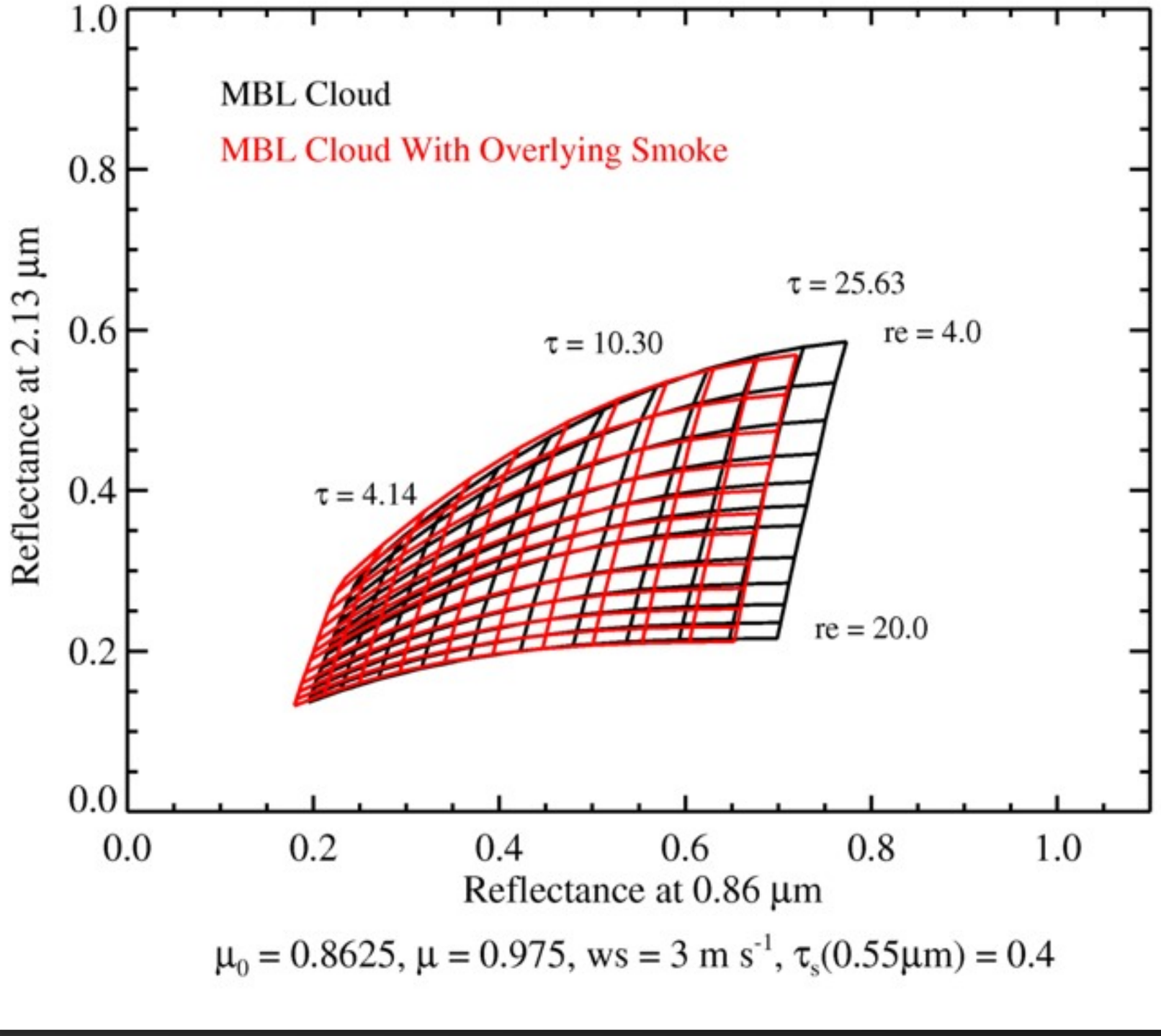
MOD04 ATBD

TABLE 4: OPTICAL PROPERTIES OF THE AEROSOL MODELS USED FOR THE V5.2 OVER-LAND LOOKUP TABLE

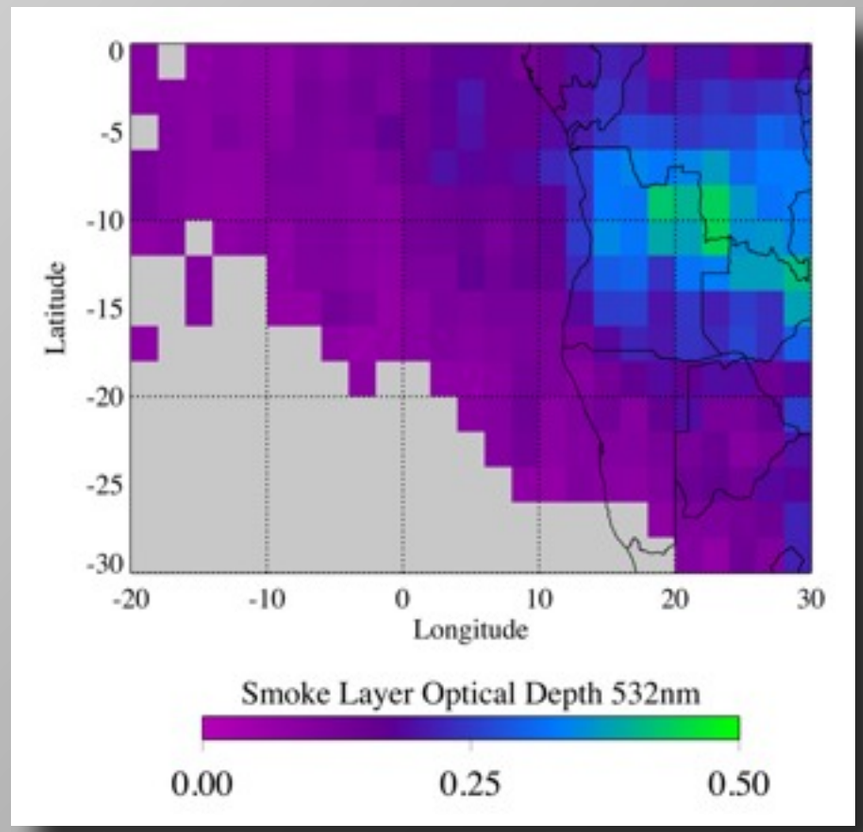
Model	Mode	r_v (μm)	σ	V_0 ($\mu m^3/\mu m^2$)	Refractive Index: k	SSA/g (0.47/0.55/0.66/2.1μM) for $\tau_{0.55} = 0.5$
Absorbing/ Heavy Smoke						0.88/0.87/0.85/0.70 0.64/0.60/0.56/0.64
	Accum	$0.0096\tau + 0.1335$	$0.0794\tau + 0.3834$	$0.1748\ \tau^{0.8914}$	1.51 – 0.02i	
	Coarse	$0.9489\tau + 3.4479$	$0.0409\tau + 0.7433$	$0.1043\ \tau^{0.6824}$	1.51 – 0.02i	

Haywood et al. (2004)

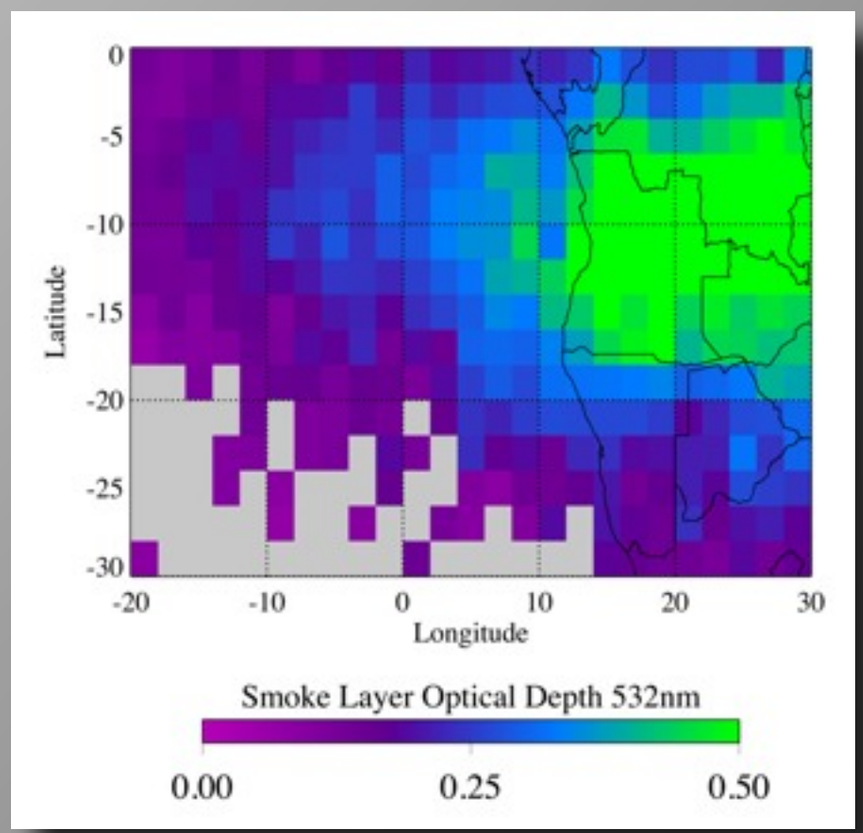
	λ = 0.55			λ = 0.63			λ = 0.87			λ = 1.63			λ = 2.13			λ = 3.7		
	ω_o	g	k_e	ω_o	g	k_e	ω_o	g	k_e	ω_o	g	k_e	ω_o	g	k_e	ω_o	g	k_e
BB	0.91	0.59	5.00	0.88	0.52	3.90	0.86	0.40	3.50	0.78	0.48	0.50	0.78	0.79	0.40	0.75	0.57	0.20
Dust	0.95	0.74	0.42	0.96	0.73	0.42	0.96	0.70	0.42	0.98	0.78	0.44	0.94	0.86	0.30	0.90	0.82	0.24


MBL Cloud
MBL Cloud With Overlying Smoke
τ = 25.63
re = 4.0
τ = 10.30
τ = 4.14
re = 20.0
Reflectance at 2.13 μm
Reflectance at 0.86 μm
0.0
0.2
0.4
0.6
0.8
1.0
μ0 = 0.8625, μ = 0.975, ws = 3 m s-1, τs(0.55μm) = 0.4

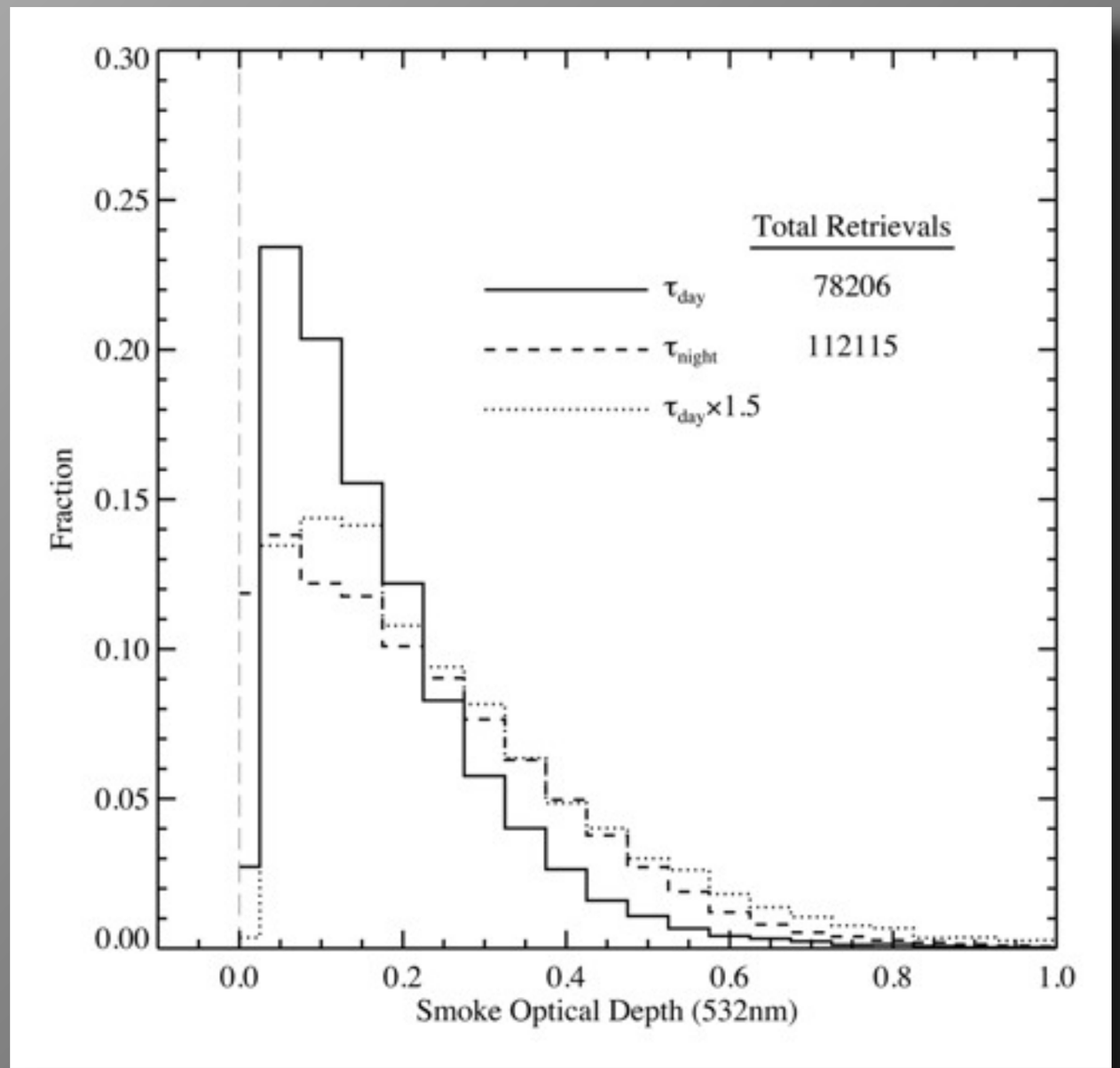
Daytime CALIOP

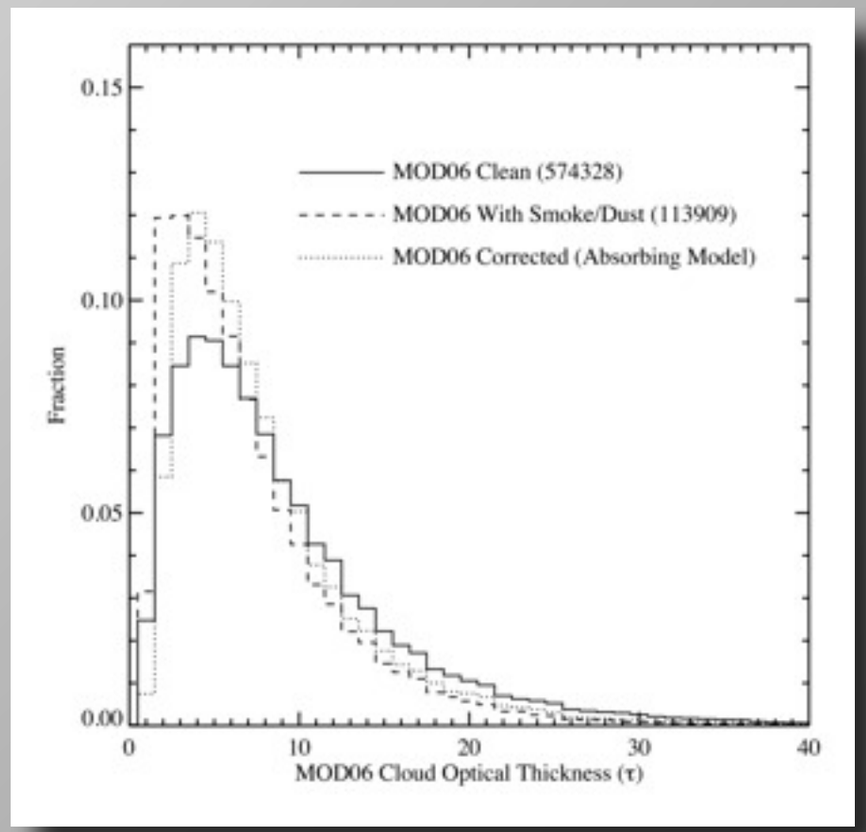


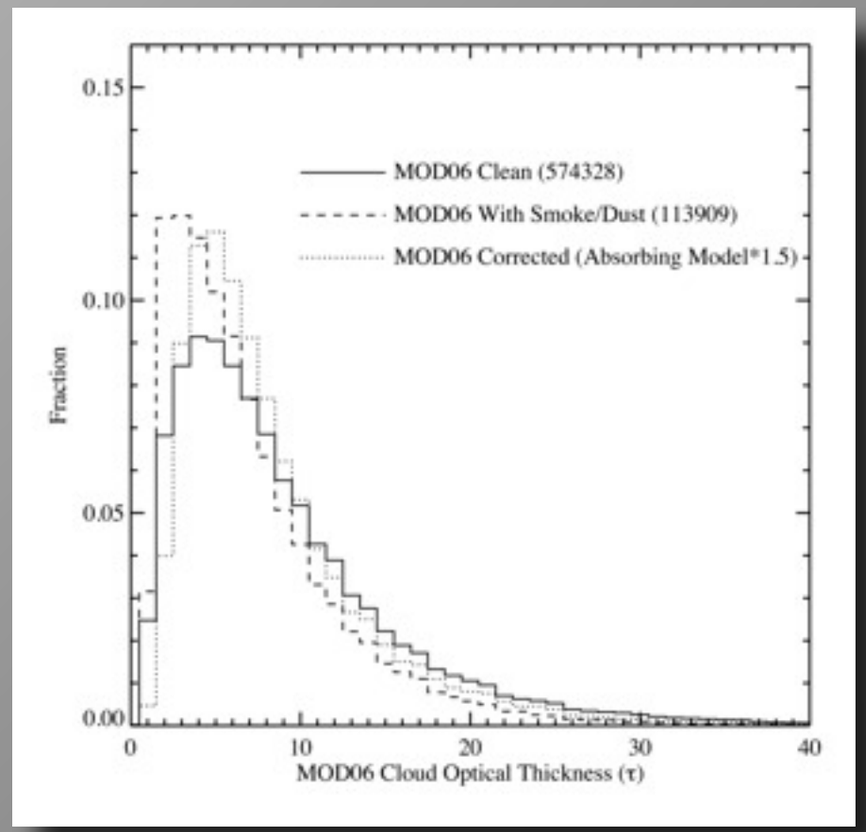
Nighttime CALIOP

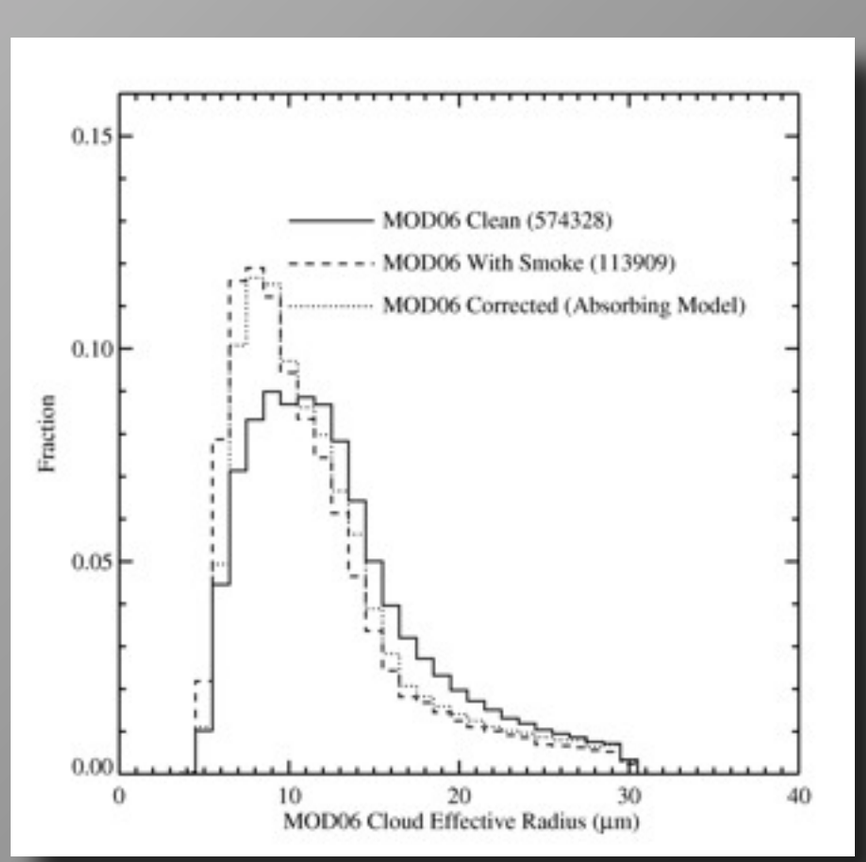


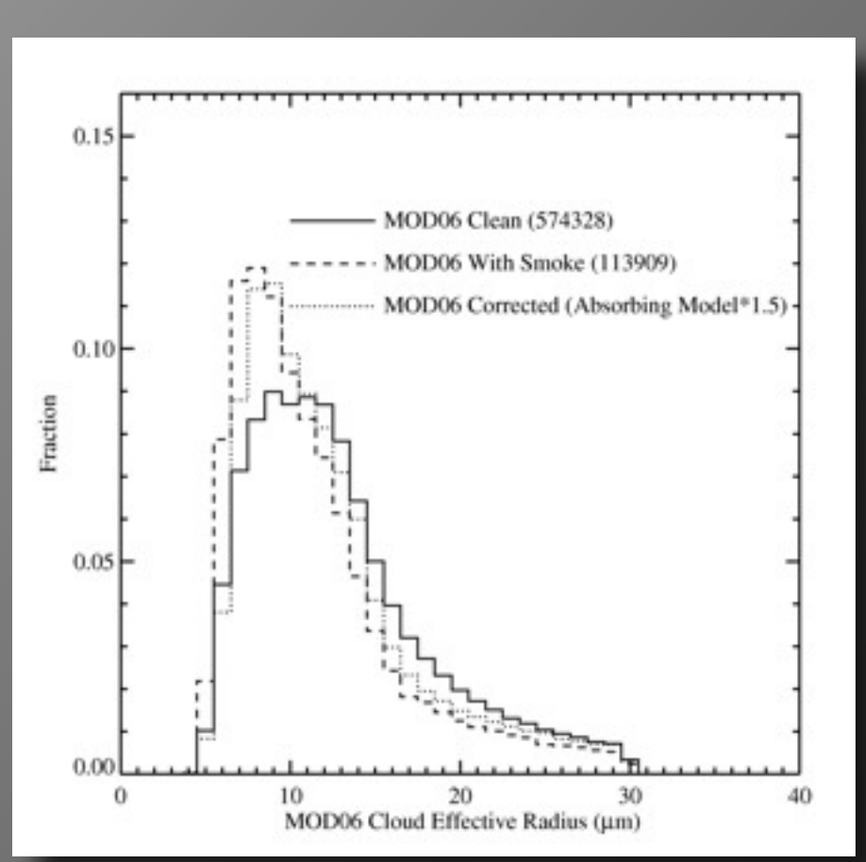
August and September 2006-2011











August and September 2006-2011

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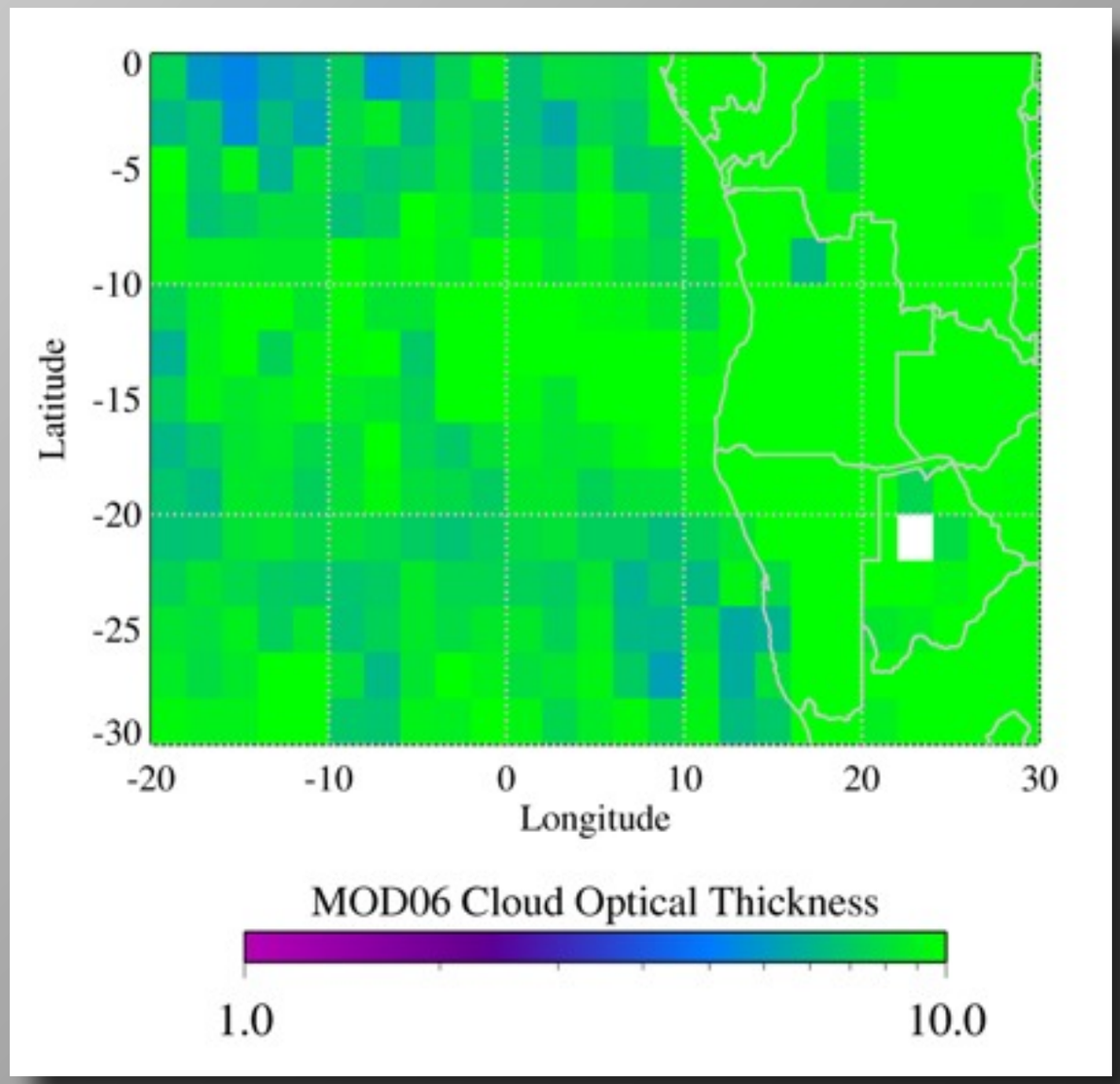

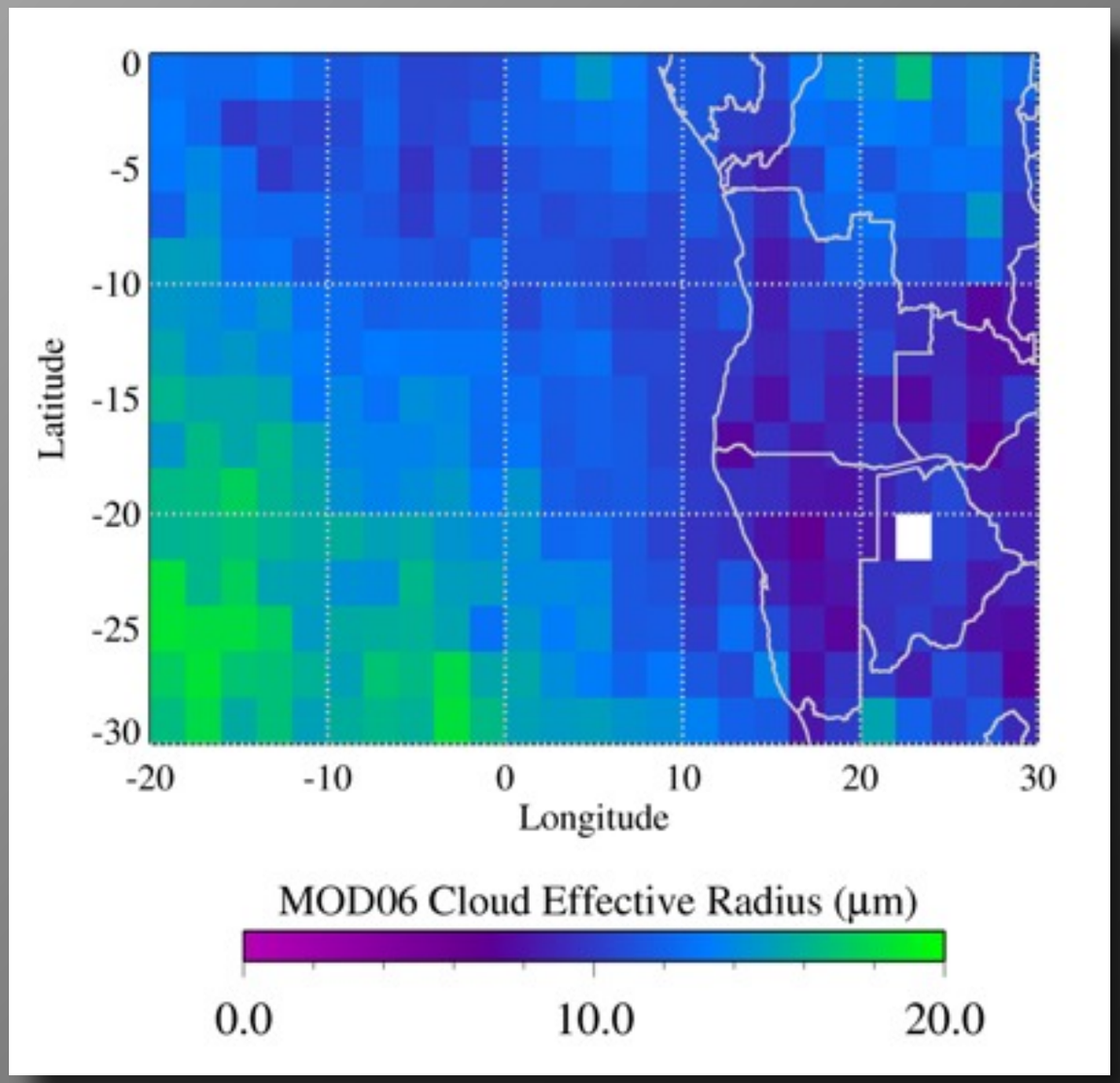

August and September 2006-2011 MOD06 C6 (CALIOP-collocated retrievals only)

Table: Scalar Statistics of MOD06 Optical Properties

CALIOP Aerosol Type		Cloud Optical Thickness		Cloud Effective Radius	
		Mean	*Median*	*Mean*	*Median*
Smoke Only	Clean	8.9	7.1	12.7	11.6
	W/Aerosol	6.6	5.2	11.5	10.0
	Corrected	7.4	6.0	12.2	10.7
	Corrected w/Scale	8.4	6.5	12.5	11.1
Smoke and Polluted Dust	Clean	9.1	7.2	12.9	11.8
	W/Aerosol	6.9	5.6	11.4	10.1
	Corrected	8.2	6.4	12.0	10.6
	Corrected w/Scale	8.9	6.8	12.2	10.9

August and September 2006-2011

Future Work

- Finish reprocessing for modified focus region.
- Assess the direct radiative forcing with corrected MOD06 cloud retrievals.
- Investigate methods for extending analysis across larger swath.

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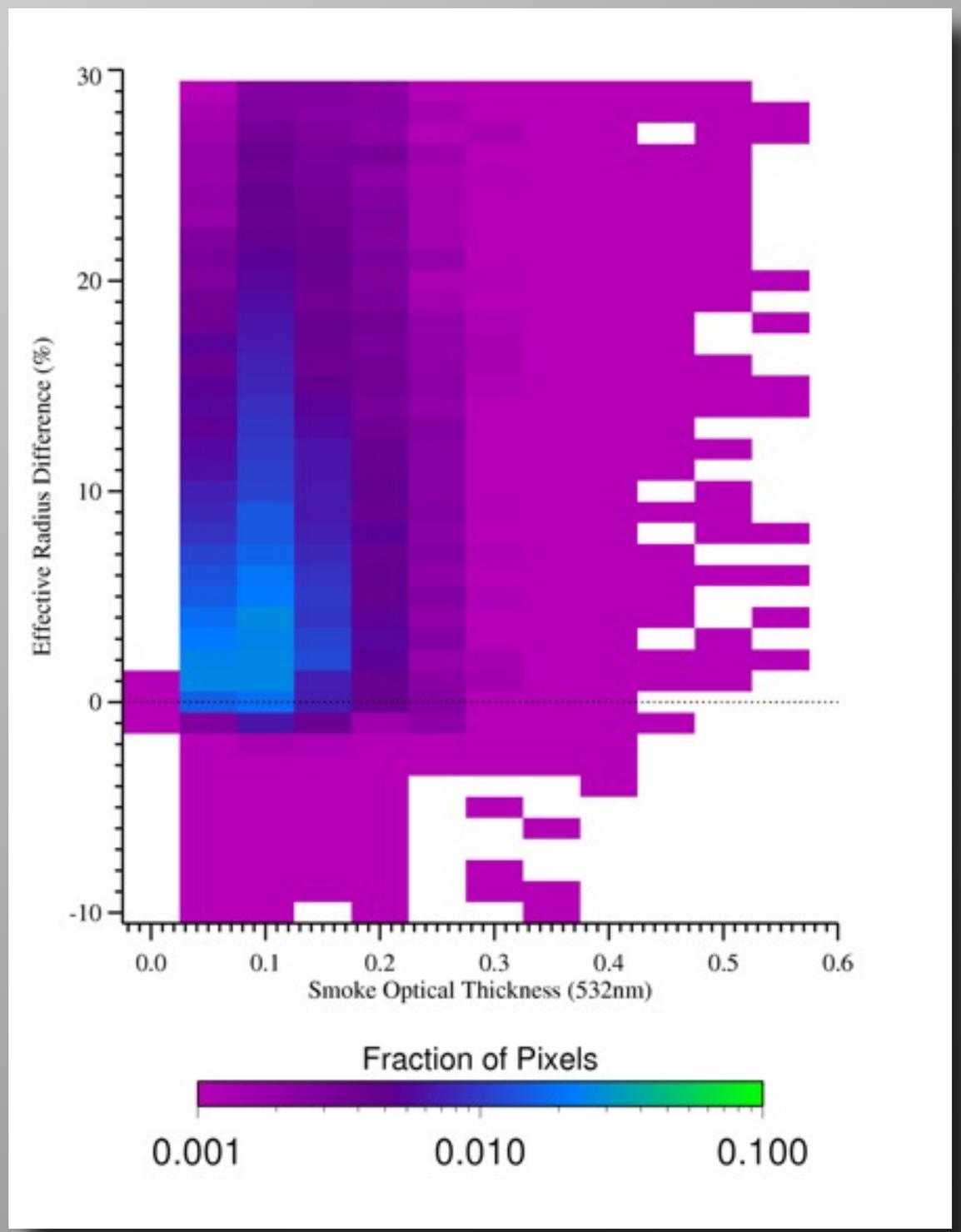
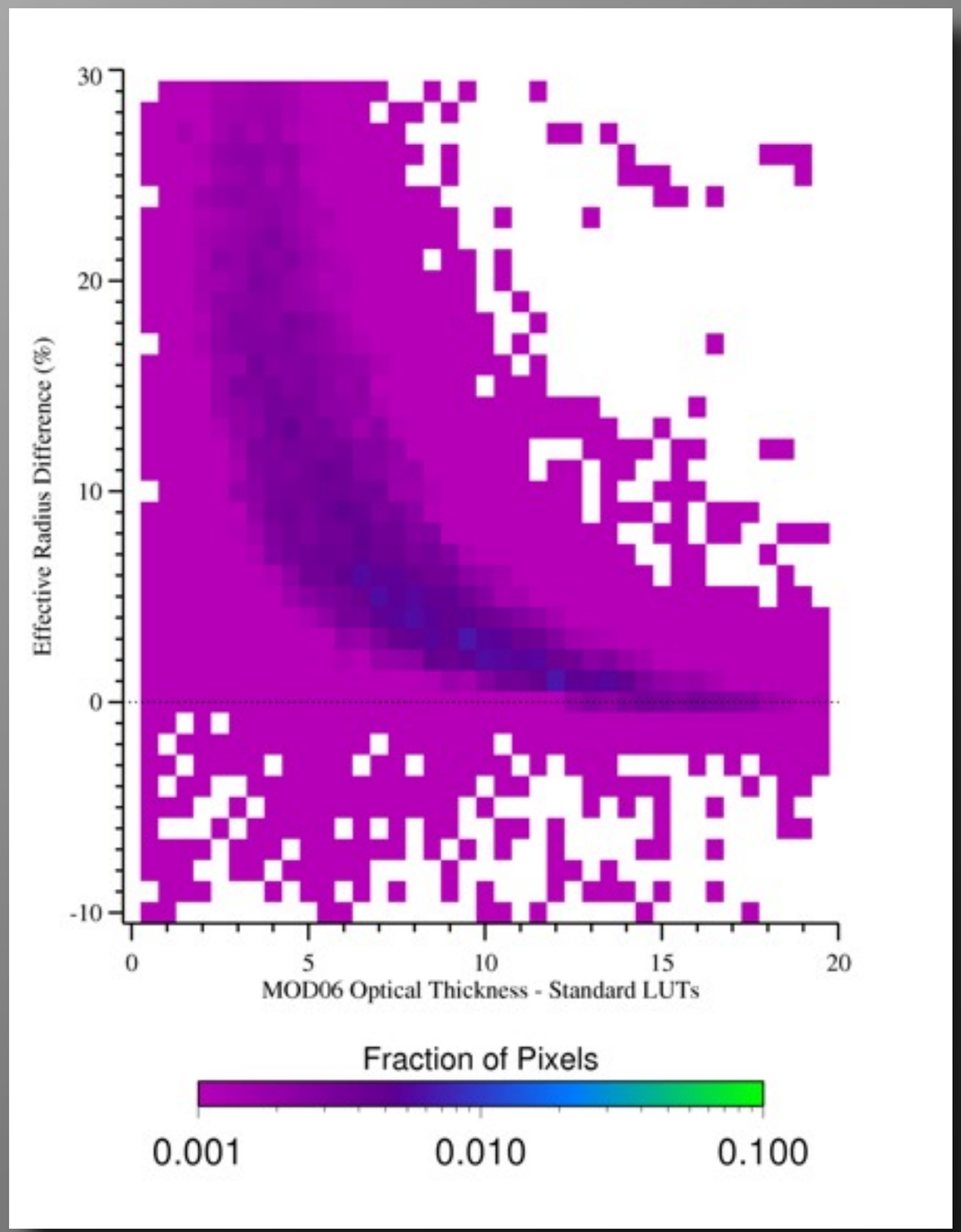

30
20
10
0
-10
Effective Radius Difference (%)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Smoke Optical Thickness (532nm)
Fraction of Pixels
0.001
0.010
0.100


30
20
10
0
-10
Effective Radius Difference (%)
0
5
10
15
20
MOD06 Optical Thickness - Standard LUTs
Fraction of Pixels
0.001
0.010
0.100